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The Healthcare Executives Role in Technology Decisions: Surgical Simulation to Reduce Training Time, Increase Case Access, Increase Expertise, and Reduce Errors

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Panelists

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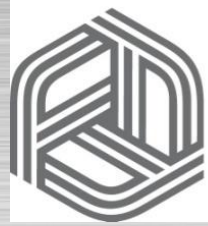
Simulation and Surgical Education

INTRODUCTION

Tim Liezert, FACHE



FLORIDA HOSPITAL
NICHOLSON CENTER
FOR SURGICAL ADVANCEMENT

Simulation in Surgical Education:

Innovation to reduce training time, increase case access, increase expertise, and reduce errors

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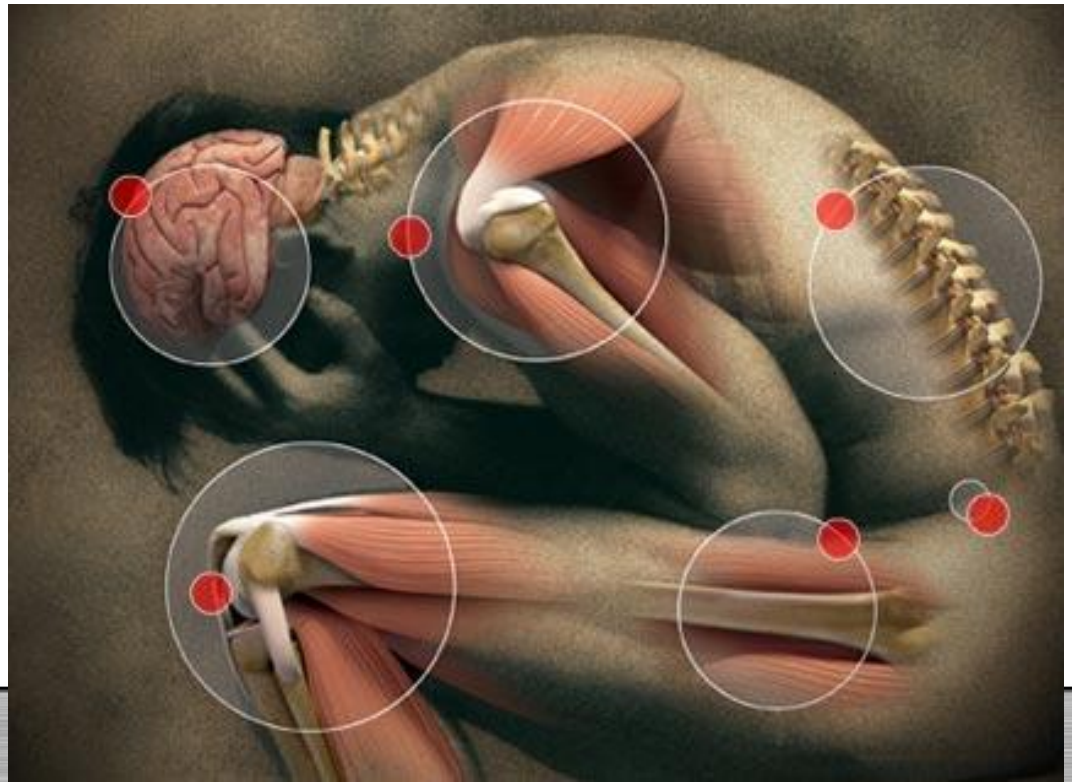
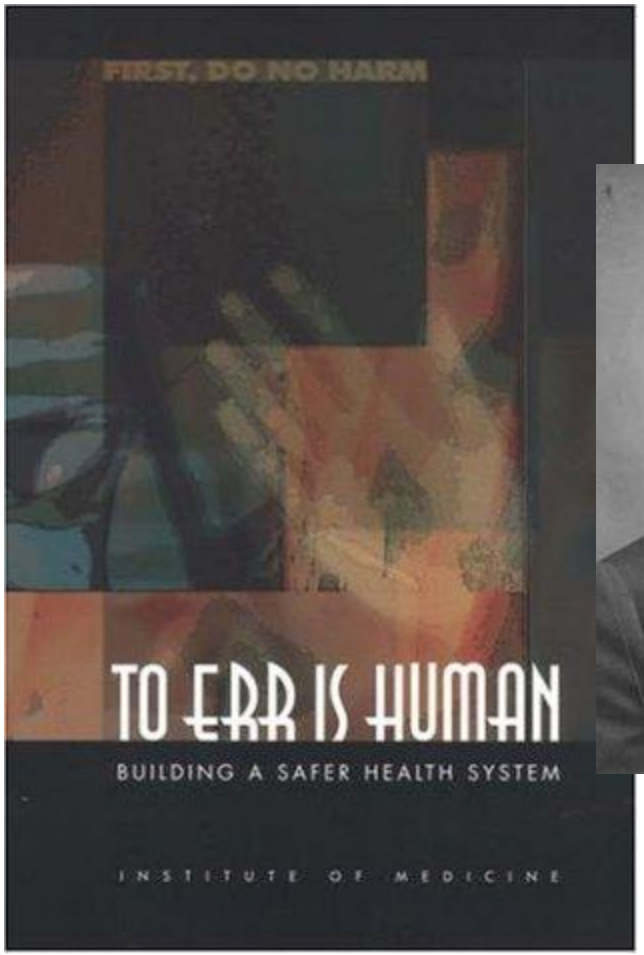
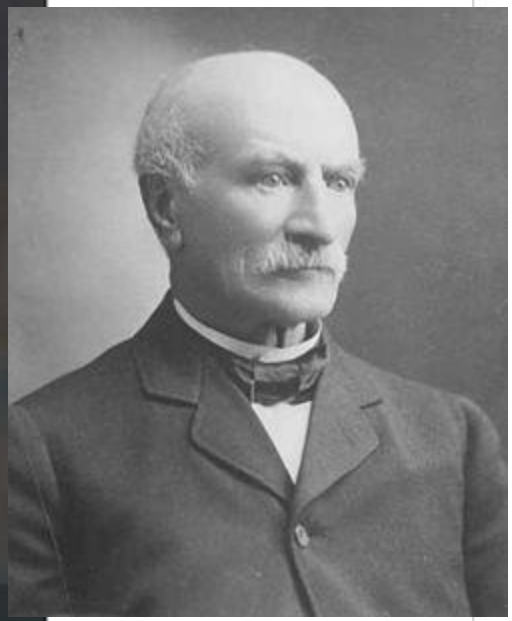
Errors Eliminate Profits

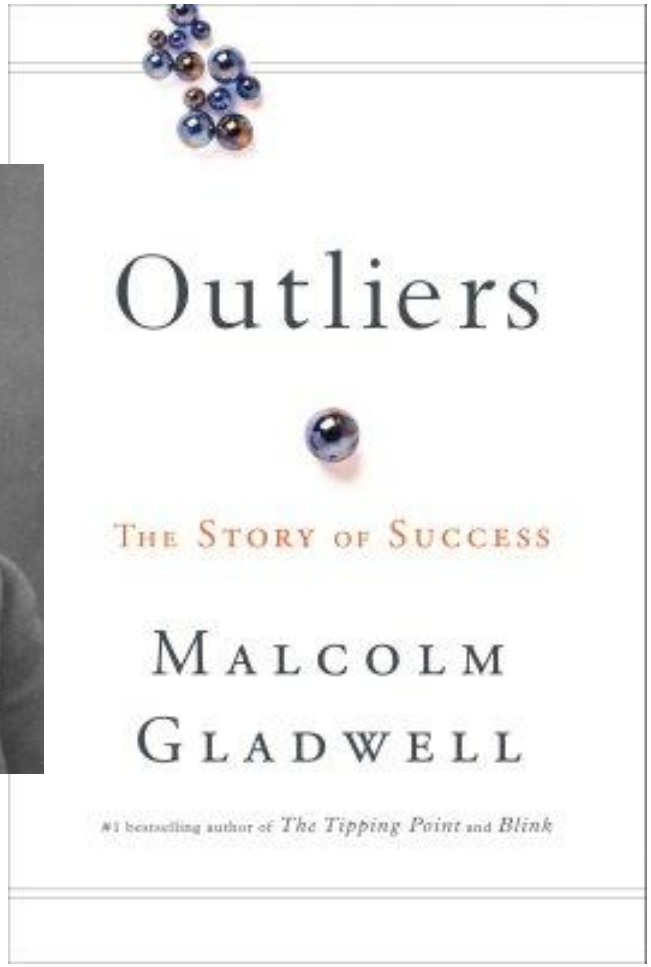
- **Minor Complication**
  - **Revisit eliminates all profit from the original surgery**
- **Major Complication**
  - **Revisit costs 3X the profit from the original surgery**



Creating Experts & Eliminating Errors







10,000 hours to become an expert - Gladwell

"There is no excuse for the surgeon to learn on the patient." – William Mayo, 1927

Medical Education – Explosion of Information

- Medical procedures are becoming more numerous and more complex – medical knowledge has “hypertrophied” (Cooke, 2006)

- Training residents to a common level of knowledge and competence is already impossible (Satava, 2008)

"The Perfect Storm" (Murphy, 2007)

- Risk to patient health. (McDougall, 2007)
- Ethics of practicing on patients. (Satava, 2004; Murphy, 2007)
- Cost is a barrier to training. (Bridges, 1999)
- Insurance coverage of educational actions. (Satava, 2004)
- Working hour limits. (Satava, 2004)
- Availability of training opportunities. (Birden, 2007; Davis, 1999)
- Access to training. (Dunkin, 2007; Spitzer, 1997)
- Complexity of modern surgery. (McDougall, 2007)
- Volume of unique procedures. (Reznick & MacRae, 2006)
- Proficiency-based Medicine. (Murray, 2005)
- Quality of technology. (Murphy, 2007)
- Expectations around computer technologies. (Murphy, 2007)
- Acceptance of technology. (Ziv, 2003)
- Learning from Mistakes. (Ziv, 2005)

Objectives for Simulation in Education

- **Objective 1: Reduce Cost**
- **Objective 2: Increase Case Access**
- **Objective 3: Reduce Training Time**
- **Objective 4: Reduce Errors**

Similar Motivations in Military, Industrial, and Medical Training

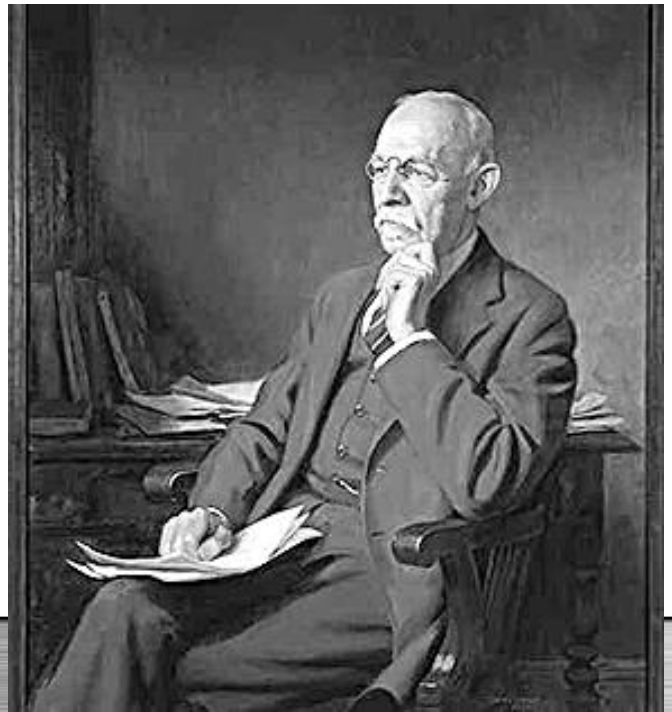
Objective 1: Reduced Cost

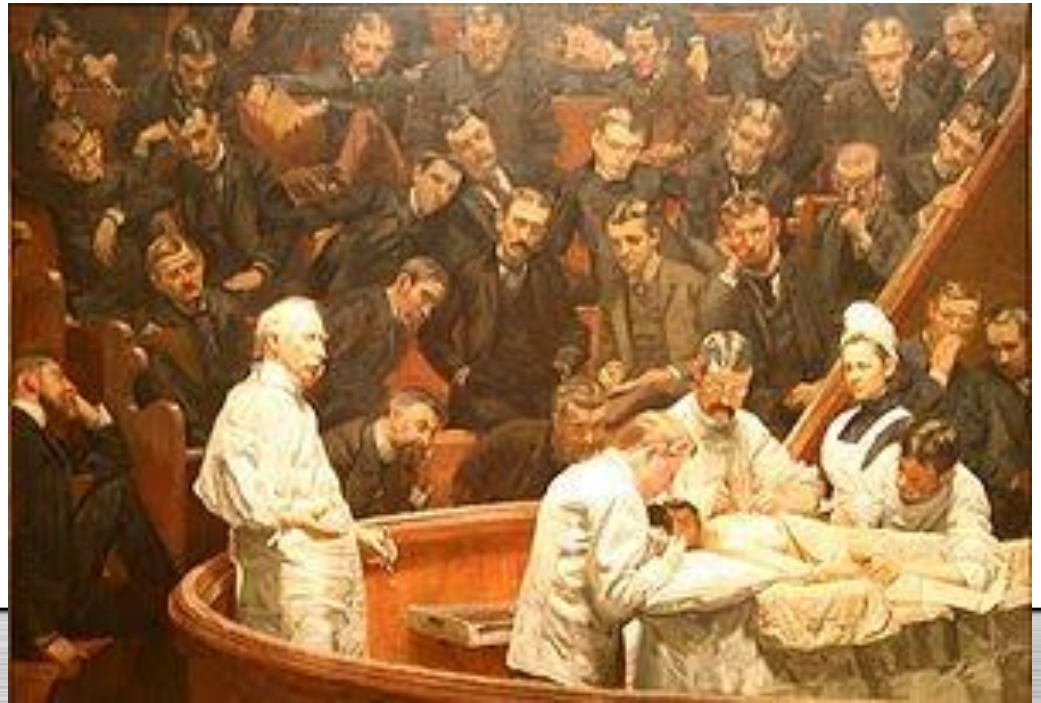
- Surgery as a teaching event consumes resources that could generate additional revenue. (Bridges & Diamond 1999)
  - 186 hours over a 4 year residency
  - Estimate OR costs at $257.40 per hour.
  - Adds $47,970 to the cost of a medical education.

- Updated: Adds $186,363 to $279,545 during four year residency
  - US OR is $1,500 per hour (Frost & Sullivan, 2004)
  - Swedish OR is $1,000 per hour (Hyltander, 2003)

Objective 2: Increased Access

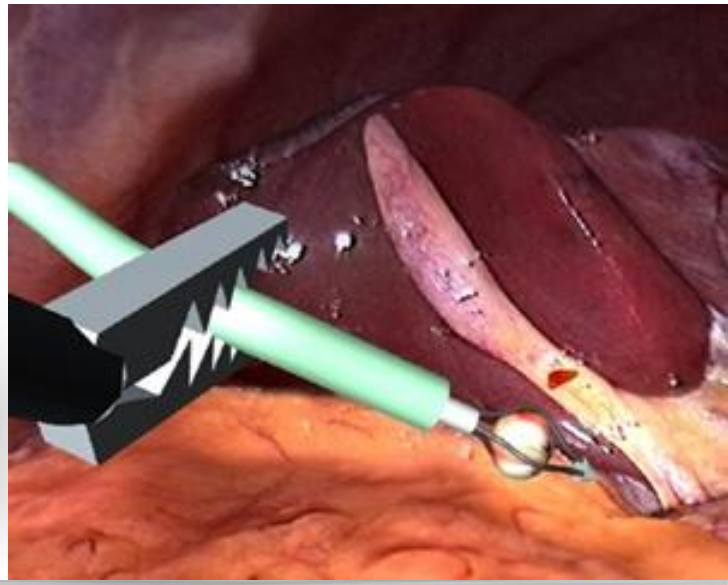
- Good laparoscopic skills cannot be developed by merely watching an expert.
- Laparoscopic proficiency is only realized after sufficient practice in the minimally invasive environment." (Pearson et al, 2002)
- Students trained in VR are 29% faster at performing laparoscopic surgeries and make up to five times fewer mistakes (Enochsson et al, 2004; and Seymour, 2002)
- Learning begins with "do one" (Jordan et al, 2001; Gallagher et al, 2001b; Madan & Frantzides, 2007).





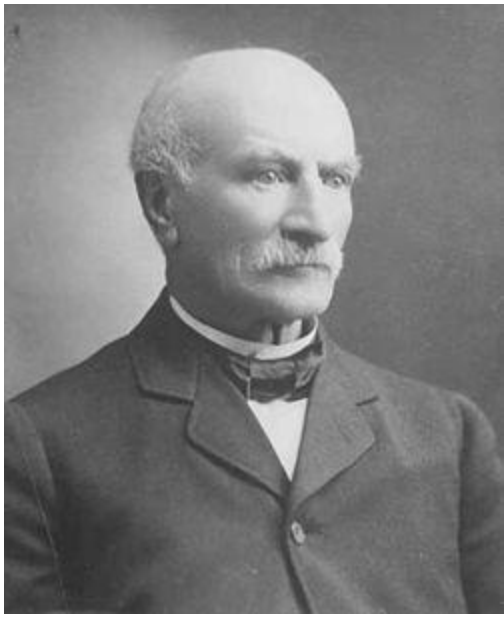
Objective 3: Reduced Time

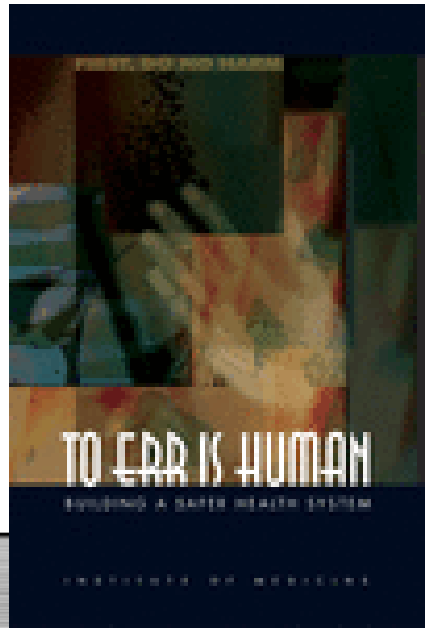
- Lap simulators differentiate experienced from inexperienced users based on their performance scores with the simulator (Adamsen et al, 2005)
- MIST-VR simulator could determine which students will never achieve proficiency and should be dropped from a training program (Gallagher et al, 2004)
- Non-VR trained students are nine times more likely to fail to make progress in their performance than those who use VR in their training (Seymour, 2002)



Objective 4: Reduced Errors

- Medical error is responsible for between 44,000 and 98,000 deaths per year (IOM, 1999).
- Laparoscopic surgery has an error rate that is three times higher than that of open surgery. Error rate has not been decreasing over an eight year period as surgeons become more experienced (Huang et al, 2005).
- In laparoscopy, observation does little to convey the skills that must be mastered. Only actual practice has been effective at this (Jordan et al, 2001; Gallagher et al, 2001b; Madan & Frantzides, 2007).
- Simulations can improve the performance of surgeons because they become familiar with the appearance of organs and tissue on a two dimensional computer monitor (Huang et al, 2005).





Misleading Assumptions in Traditional Education

- Assumption 1: Didactic Education is Effective
  - Though surgeons or residents may learn new information during educational lectures, they do not incorporate it into their practice. It has no impact on their actions in delivering medicine. (Davis et al 1995 & 1999; Weller et al 2005)
- Assumption 2: Sufficient Access to Faculty and Patients is Possible
  - Availability of faculty is a major limitation in medical education (Dunkin et al, 2007; Satava, 2008)
  - Many studies assume adequate access a priori (Gerson & Van Dam, 2003)
- Assumption 3: Practicing on Live Patients is Acceptable
  - Medical schools, faculty, and residents are finding new restrictions on the type and amount of training that can be conducted with a live patient (Murphy et al, 2007; Murray et al, 2005; Satava, 2004a; Ziv et al, 2005).

Training Technology Options

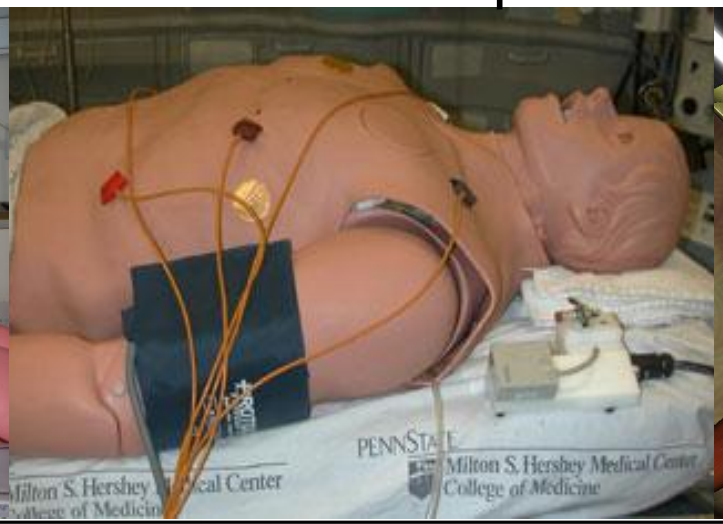
Human

Animal

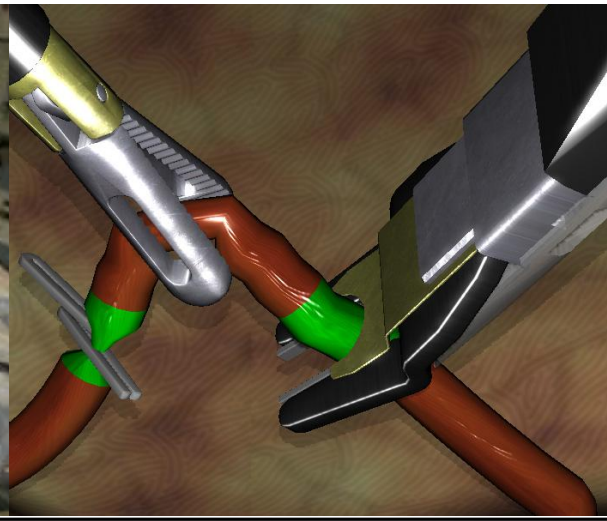
Box Trainer

Part Task

Mannequin



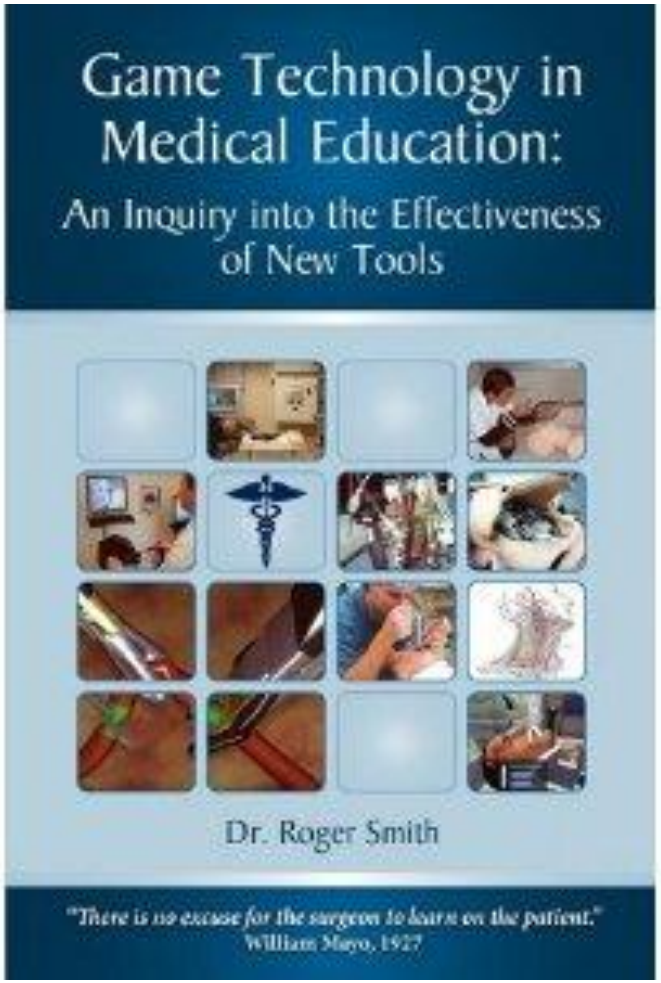
VR/Game Tech



Human	Animal	Box Trainer	Mannequin	Simulation	VR/Game
Learn on humans: Living patients, the newly dead, and cadavers	**Learn on animals:** Living and newly dead pigs, cats, and others	**Learn on organs in a box:** Human-shaped box contains organs, tissue, or test devices	**Learn on a physical replica:** A full-body device with synthetic skin, organs, and fluids	**Learn on an animated machine:** Includes computer, hydraulics, pneumatics, and electrical responses	**Learn on computer images:** Mathematical models, visual images, sounds, and some tactile feedback
Advantage Exact Replica, Existing OR	**Advantage** Similarities, Availability	**Advantage** Availability, Convenience, Human Shape	**Advantage** Human Shape, Logistics	**Advantage** Rich Experience, Multi-Function, Programmable	**Advantage** Rich Experience, Flexibility, Low Cost
Disadvantage Scarcity, Single Use, Ethical Issues	**Disadvantage** Anatomy, Single Use, Social Mores	**Disadvantage** Not Alive, Single Use, Animal Organs	**Disadvantage** Static, Lacks Realism	**Disadvantage** High Cost, Complexity	**Disadvantage** Screen-barrier, Non-tactile
Examples Cadavers Live Patients	**Examples** Porcine Labs	**Examples** MIC-Trainer	**Examples** CPR Annie	**Examples** Sim One HPS	**Examples** MIST-VR dV-Trainer

Complete Research Study

Game Technology in Medical Education. Roger Smith, 2009. [Available at Amazon.com]



References (1)

- Cooke, M., Irby, D., Sullivan, W., & Ludmerer, K. (2006, September 28). American medical education 100 years after the Flexner report. *The New England Journal Of Medicine*, *355*(13), 1339-1344.
- Denson JS, Abrahamson S. A computer-controlled patient simulator. *Journal of the American Medical Association* 1969; 208:504–8.
- Satava, R. (2004a, May 19). Disruptive visions: surgical education. *Surgical Endoscopy*, 18(5), 779-781.
- Murphy, J., Torsher, L., & Dunn, W. (2007, March). Simulation medicine in intensive care and coronary care education. *Journal Of Critical Care*, 22(1), 51-55.
- Murray, D., Boulet, J., Kras, J., Woodhouse, J., Cox, T., & McAllister, J. (2004, November). Acute care skills in anesthesia practice: a simulation-based resident performance assessment. *Anesthesiology*, 101(5), 1084-1095.
- McDougall, E. (2007, March). Validation of surgical simulators. *Journal Of Endourology / Endourological Society*, 21(3), 244-247.
- Reznick, R.K. and MacRae, H. (2006, December 21). Teaching surgical skills – changes in the wind. *New England Journal of Medicine*, 355(25), 2664-2669.
- Ziv, A., Ben-David, S., & Ziv, M. (2005, May). Simulation based medical education: an opportunity to learn from errors. *Medical Teacher*, 27(3), 193-199.
- Ziv, A., Wolpe, P., Small, S., & Glick, S. (2003, August). Simulation-based medical education: an ethical imperative. *Academic Medicine: Journal Of The Association Of American Medical Colleges*, 78(8), 783-788.
- Spitzer, V. (1997, Autumn). The visible human: a new language for communication in health care education. *Caduceus*, 13(2), 42-48.
- Dunkin, B., Adrales, G., Apelgren, K., & Mellinger, J. (2007, March 16). Surgical simulation: a current review. *Surgical Endoscopy*, *21*(3), 357-366.
- Davis D, Thomson M, O'Brien M, et al. (1999) Impact of formal continuing medical education: do conferences, workshops, rounds and other traditional continuing education activities change physician behaviour or health care outcomes. *Journal of the American Medical Association*, 282, 867–74.

References (2)

- Birden, H. and Page, S. (2007, August). 21st century medical education. *Australian Health Review*, 31(3), 341-350.
- Hyltander, A. (2003, June). Simulation as a teaching alternative: Utopia or reality. *CAL-aborate*, 10. Retrieved May 1, 2008 from http://science.uniserve.edu.au/pubs/callab/vol10/hyltand.html.
- Frost & Sullivan. (2004). Return on investment study for medical simulation training: Immersion Medical, Inc. Laparoscopy AccuTouch System. Industrial research report available at: http://www.immersion.com/medical/products/laparoscopy/roi/FS_IMMRmed_laparoscopy_ROI_V2.pdf
- Gallagher, H., Allan, J., & Tolley, D. (2001b, November). Spatial awareness in urologists: are they different?. *BJU International*, *88*(7), 666-670.
- Grantcharov, T., Bardram, L., Funch-Jensen, P., & Rosenberg, J. (2003b, July 6). Impact of hand dominance, gender, and experience with computer games on performance in virtual reality laparoscopy. *Surgical Endoscopy*, *17*(7), 1082-1085.
- Jordan, J., Gallagher, A., McGuigan, J., & McClure, N. (2001, October). Virtual reality training leads to faster adaptation to the novel psychomotor restrictions encountered by laparoscopic surgeons. *Surgical Endoscopy*, *15*(10), 1080-1084.
- Madan, A., & Frantzides, C. (2007, January). Substituting virtual reality trainers for inanimate box trainers does not decrease laparoscopic skills acquisition. *JSLS: Journal Of The Society Of Laparoendoscopic Surgeons / Society Of Laparoendoscopic Surgeons*, *11*(1), 87-89.
- MacFadyen, B., Vecchio, R., Ricardo, A., & Mathis, C. (1998, April). Bile duct injury after laparoscopic cholecystectomy. The United States experience. *Surgical Endoscopy*, *12*(4), 315-321.
- Brunner, W., Korndorffer, J., Sierra, R., Dunne, J., Yau, C., Corsetti, R., et al. (2005, January). Determining standards for laparoscopic proficiency using virtual reality. *The American Surgeon*, *71*(1), 29-35.
- McClusky, D., Ritter, E., Lederman, A., Gallagher, A., & Smith, C. (2005, January). Correlation between perceptual, visuo-spatial, and psychomotor aptitude to duration of training required to reach performance goals on the MIST-VR surgical simulator. *The American Surgeon*, *71*(1), 13.

References (3)

- Bridges, M., & Diamond, D. (1999, January). The financial impact of teaching surgical residents in the operating room. *American Journal Of Surgery*, *177*(1), 28-32.
- Grantcharov, T., Kristiansen, V., Bendix, J., Bardram, L., Rosenberg, J., & Funch-Jensen, P. (2004, February). Randomized clinical trial of virtual reality simulation for laparoscopic skills training. *The British Journal Of Surgery*, *91*(2), 146-150.
- Adamsen, S., Funch-Jensen, P., Drewes, A., Rosenberg, J., & Grantcharov, T. (2005, February 2). A comparative study of skills in virtual laparoscopy and endoscopy. *Surgical Endoscopy*, *19*(2), 229-234.
- Enochsson, L., Isaksson, B., Tour, R., Kjellin, A., Hedman, L., Wredmark, T., et al. (2004, November). Visuospatial skills and computer game experience influence the performance of virtual endoscopy. *Journal Of Gastrointestinal Surgery: Official Journal Of The Society For Surgery Of The Alimentary Tract*, *8*(7), 876.
- Seymour, N., Gallagher, A., Roman, S., O'Brien, M., Bansal, V., Andersen, D., et al. (2002, October). Virtual reality training improves operating room performance: results of a randomized, double-blinded study. *Annals Of Surgery*, *236*(4), 458.
- Huang, J., Payandeh, S., Doris, P., & Hajshirmohammadi, I. (2005). Fuzzy classification: towards evaluating performance on a surgical simulator. *Studies In Health Technology And Informatics*, *111*, 194-200.
- Institute of Medicine (1999). *To err is human: Building a safer health system*. Washington, D.C.: National Academy Press.
- Eastridge, B., Hamilton, E., O'Keefe, G., Rege, R., Valentine, R., Jones, D., et al. (2003, August). Effect of sleep deprivation on the performance of simulated laparoscopic surgical skill. *American Journal Of Surgery*, *186*(2), 169-174.

Q & A